ADAPTIVE SWITCHING DETECTION ALGORITHM IN TURBO-MIMO SYSTEMS ENABLING POWER SAVINGS

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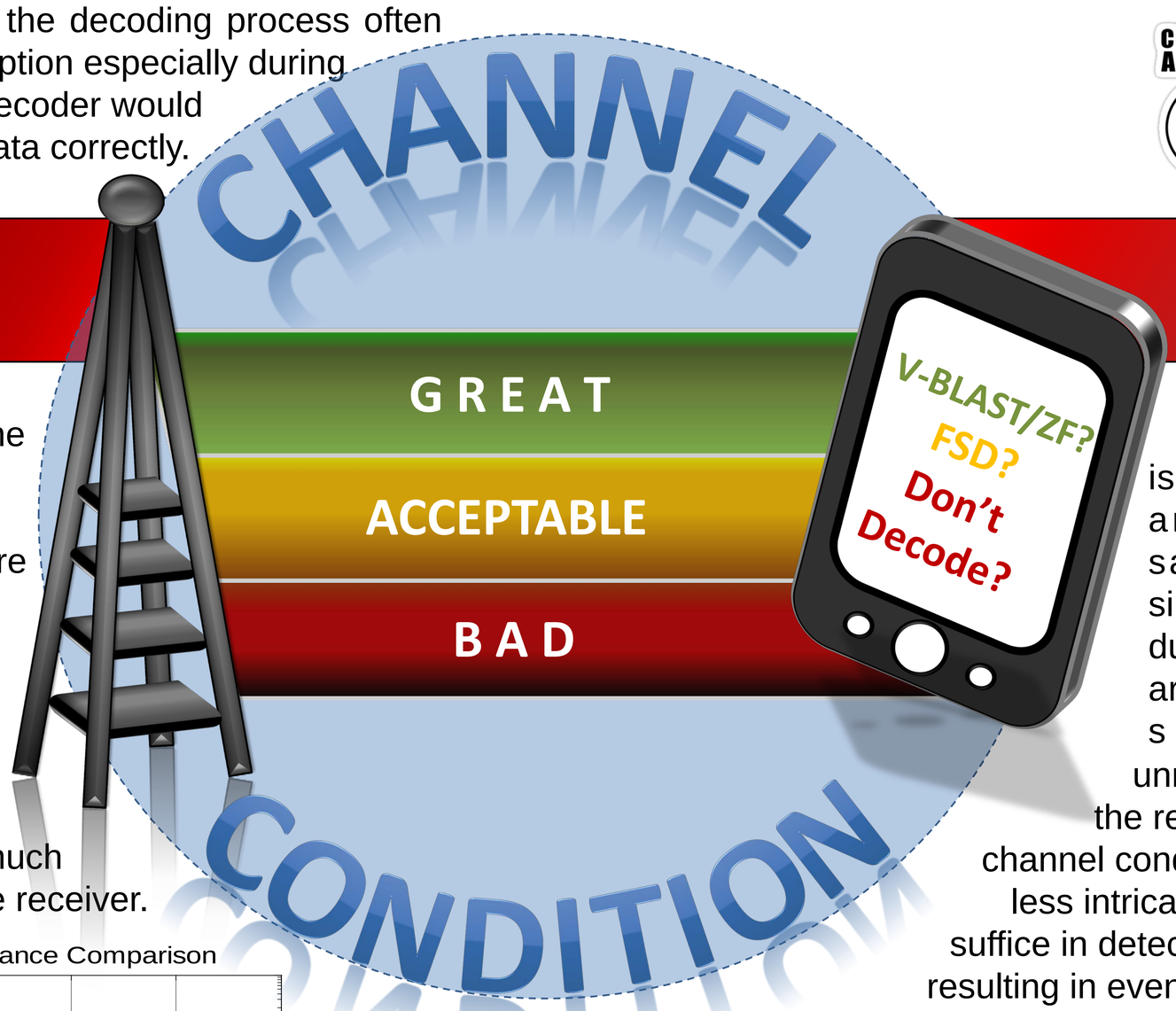
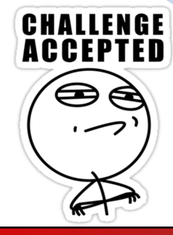
INTRODUCTION

This poster reports on a new adaptive detection algorithm for Multiple-In Multiple-Out (MIMO) bit interleaved coded modulation systems based on switching detection methods for the Fixed Complexity Sphere Decoder (FSD) [1] and the Vertical Bell Laboratories Space-Time Zero Forcing (V-BLAST/ZF) [2]. The main objective of this project is to reduce the complexity and energy consumption of the overall MIMO receiver by developing a switching mechanism within the detector. Turbo-MIMO provides a near maximum likelihood (ML) detection performance, however, due to its iterative nature, the decoding process often leads to unnecessary power consumption especially during ill conditioned channels, where the decoder would be unlikely to succeed in detecting data correctly.

PROPOSED SOLUTION

The new adaptive algorithm prevents the receiver from doing such extensive computations during these conditions, ultimately leading to significant energy savings. The threshold behaviour of the detectors are analysed via Mutual Information (MI) between the transmitted and received symbols with respect to the instantaneous channel conditions. This proposed algorithm utilises multiple thresholds to intelligently switch the detection scheme according to the current environment. This 'intelligence' is the key to efficient energy saving in the receiver.

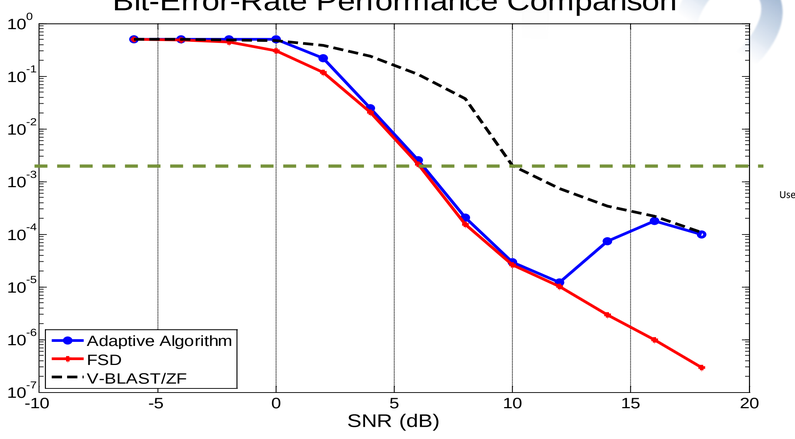


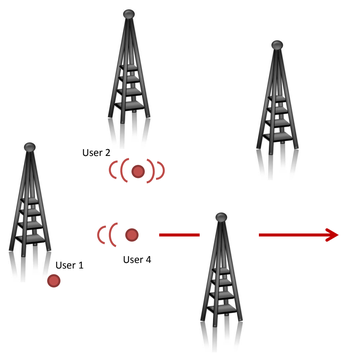


RESULTS

Simulation result in Figure 1 shows the performance of the new adaptive algorithm in comparison to the single FSD and V-BLAST/ZF methods, where the Bit-Error-Rate (BER) curve sits in between the two existing detection methods. Not only does the new adaptive algorithm give a promising BER result, which is lower than the set 10^{-3} error tolerance curve (shown in green), it also provides a much lower computational complexity in the receiver.

FIGURE 1





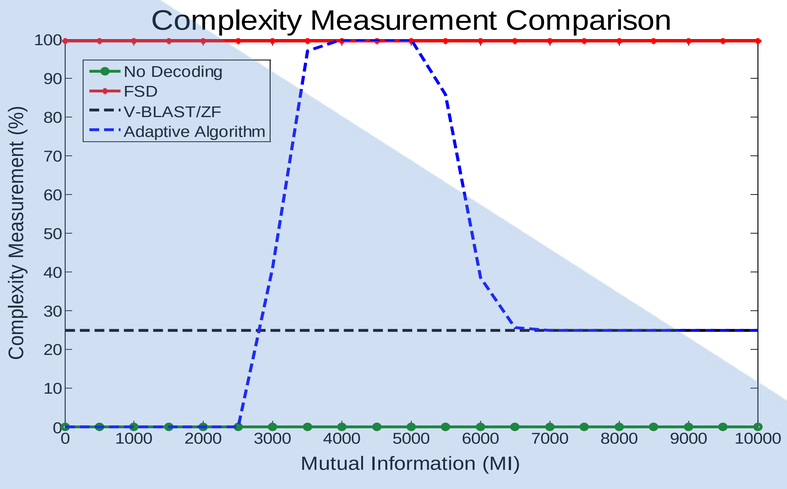
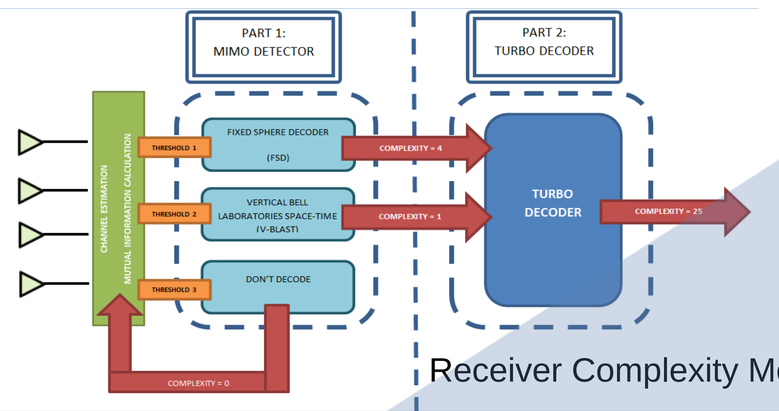


FIGURE 2

RESULTS

Complexity comparison is shown Figure 2. There are significant energy savings in the decoder since decoding procedures during ill channel conditions are avoided thus saving a significant amount unnecessary computations in the receiver. Similarly, when the channel conditions are good enough, a less intricate detection method would suffice in detecting the symbols correctly, resulting in even more power being saved. The proposed algorithm offers a significant reduction in terms of complexity along with a satisfactory performance for the system.

FIGURE 3



Receiver Complexity Model

FUTURE WORK

The proposed algorithm offers a significant reduction in terms of complexity coupled with a satisfactory performance for the system. The next step is to parallelise the algorithm for hardware implementation in order to save more energy.

References:

[1] Jiaxi Xiao, Ma, Xiaoli , McLaughlin, S.W., "**Quantifying Information Rate Loss with Zero Forcing and Maximum Likelihood Detectors**", IEEE International Conference on Acoustic Speech and Signal Processing, March 2010, Pg. 3342 – 3345

[2] L. Barbero, J. Thompson, "**Extending a Fixed-Complexity Sphere Decoder to Obtain Likelihood Information for Turbo-MIMO Systems**", IEEE Transactions on Vehicular Technology, September 2008, Pg 2804-2814

[3] G.D. Golden, C.J. Foschini, R.A. Valenzuela, P.W. Wolniasky, "**Detection Algorithm and Initial Laboratory results using V-BLAST space-time Communication Architecture**", Electronic Letters, January 1999

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